

ASPECTS OF REPRODUCTION OF THE MULLET

LIZA ABU (HECKEL) (PISCES, MUGILIDAE)

IN AL-HAMMAR MARSH, IRAQ

by

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ABSTRACT. — The reproductive cycle of *Liza abu* was studied. Six maturity stages for females and five for males are described. Results show that this species has a prolonged breeding period extending from November to March during which two batches of eggs could be shed. No significant differences between the number of males and females were found. Female and male *L. abu* mature at the end of their first year of life when they are 100 mm in total length.

RÉSUMÉ. — Le cycle sexuel de *Liza abu* a été étudié. Six stades de maturité sont décrits pour les femelles et cinq pour les mâles. Les résultats montrent que cette espèce présente une longue période de reproduction qui s'étend de novembre à mars et au cours de laquelle deux pontes peuvent être faites. Aucune différence significative n'a pu être montrée entre les nombres de mâles et de femelles. Les deux sexes de *Liza abu* atteignent leur maturité dès la fin de leur première année pour une taille de 100 mm de longueur totale.

The distribution of *Liza abu* is restricted to Iraq and Syria (Beckman, 1962). Like many other Mulletts this species is of high commercial importance especially in the southern part of Iraq where the huge area of marshes represents the main biotope for this species. Details of the biology of many mugilid species are available in many parts of the world. In Iraq, however, work has concentrated mainly on the food and growth of *L. abu* (Sharma & Al-Nassiri, 1977; Al-Nassiri *et al.*, 1978; Al-Nassiri & Sirajul Islam, 1978; Barak, 1978 and Ahmed & Hussein, 1982).

The present study deals with reproduction of *L. abu* in Al-hammar marsh. This aspect of the species biology is vitally important in development and management of its fishery.

MATERIALS AND METHODS

The fish used in this study were obtained from the South-eastern part of Al-hammar marsh, North Basrah (Fig. 1) during the period from December 1980 to

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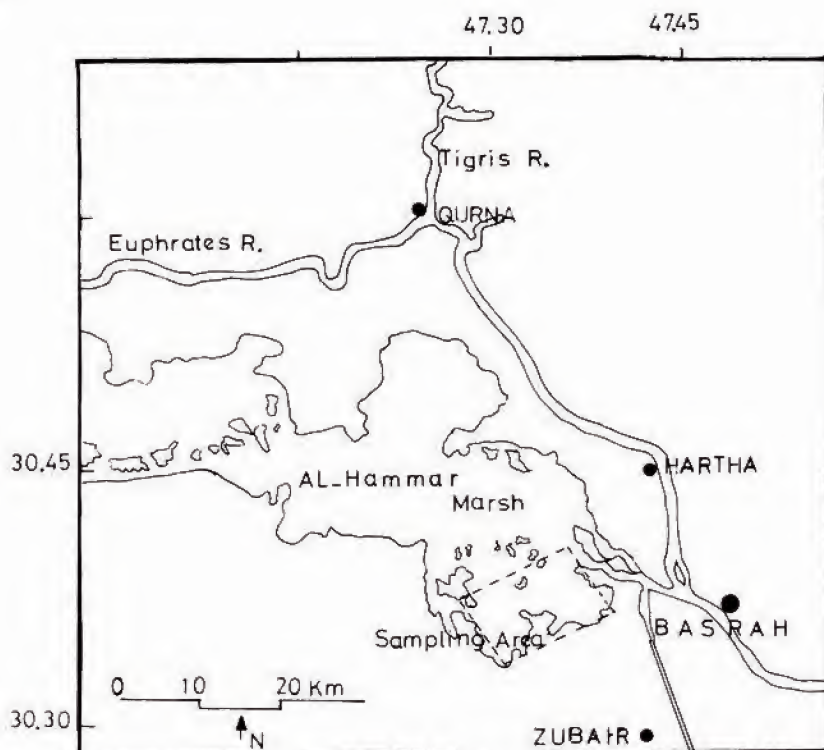


Fig. 1. - Map of Al-hammar marsh showing the sampling area.

November 1981. Fish were caught by gill nets of mesh size 23, 26, 33, and 75 mm. All fish were preserved immediately in ice and taken to the laboratory. The total fish length was measured to the nearest mm and the body weight was recorded to the nearest g. The sex and stage of maturity were also determined. Ovaries and testies were then carefully removed, weighed to the nearest 0.01 g and all morphological features recorded. The ovaries were preserved in 10 % formaline for subsequent examination. Measurements of ova diameter were carried out on 39 ovaries within maturity stages 2 - 6 according to the method recommended by Clark (1934). The χ^2 test was applied to determine any deviation of the sex ratio from an expected 1:1 ratio. Age of all fish was determined from their scales. The total number of fish caught during the sampling period was 430, ranging in length from 44 to 222 mm.

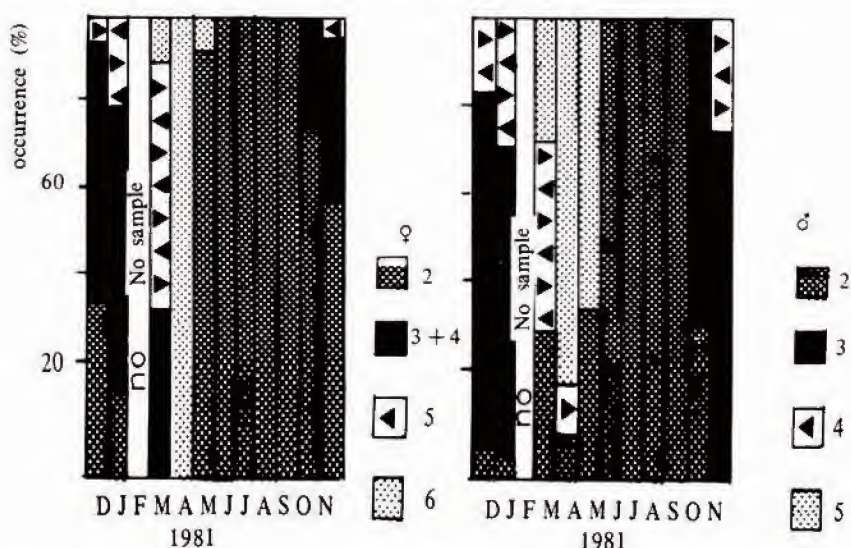
RESULTS

The maturity stages

An arbitrary classification of gonad condition was used to characterize the different stages of the gonad during and after the breeding season. The stages of gonad maturity were standardized according to the shape of the gonad, the proportion of the body cavity it occupies, the colour and diameter of ovarian eggs, the condition

Table I. – The maturity stage of *L. abu*.

Maturity stage	Ovary	Description Testis
1. <i>Immature</i>	Sexes indistinguishable, gonads transparent, thread like (G.S.I. 0.01)	
2. <i>Resting</i>	Ovary small, faint pink colour. Ova not visible by eye, transparent, its diameter not more than 0.15 mm (G.S.I. 0.55)	Testis long threadlike with faint pink to white colour (G.S.I. 0.23)
3. <i>Early ripening</i>	Ovary pink to faint yellow colour, occupy one half of body cavity with clearly visible ova measuring 0.1-0.6 mm in diameter (G.S.I. 3.02)	Wide lobes, milky white, slight vascularisation of testes. Occupy about two third the body cavity. (G.S.I. 3.02)
4. (for female only) <i>Late ripening</i>	Ovary fully swollen, clear vascularization. Occupy two thirds of body cavity. Ova diameter 0.1-0.7 mm (G.S.I. 8.12)	
5. for females and 4. for males <i>Ripes</i>	Ovary fully swollen, soft, transparent yellowish, easily extruded by slight pressure. Occupies all body cavity. Maximum ova diameter 0.75 mm (G.S.I. 17.52)	Clear vascularization. Fully developed testes, milt could be easily extruded. Testes occupy all body cavity. (G.S.I. 11.08)
6. for females and 5. for males <i>Spent</i>	Ovary flaccid, saclike, deep red in colour, occupying one fourth of body cavity. Ova small with diameter range from 0.05-0.2 mm, there are few large yellowish ova (G.S.I. 0.37)	Flattened with white spots of milt. Occupying one fourth of body cavity. (G.S.I. 0.16)

Fig. 2. – Monthly distribution of the maturity stages of male and female *Liza abu*.

of the milt in the testies and the gonado-somatic index. Six maturity stages were distinguished for female and five for male (Table I). Figure 2 shows the monthly distribution of the maturity stages of both sexes in the period from December 1980 to November 1981. Stage 1 is not represented in figure 2 because it describes immature fish. The time sequence of the appearance of the maturity stages of the male coincides with that of the female. Stage 2 of maturity (resting) appeared in all males and females caught during June to September while no fish in this stage was caught during March and April. Stages 3 and 4 (early ripening and late ripening) are

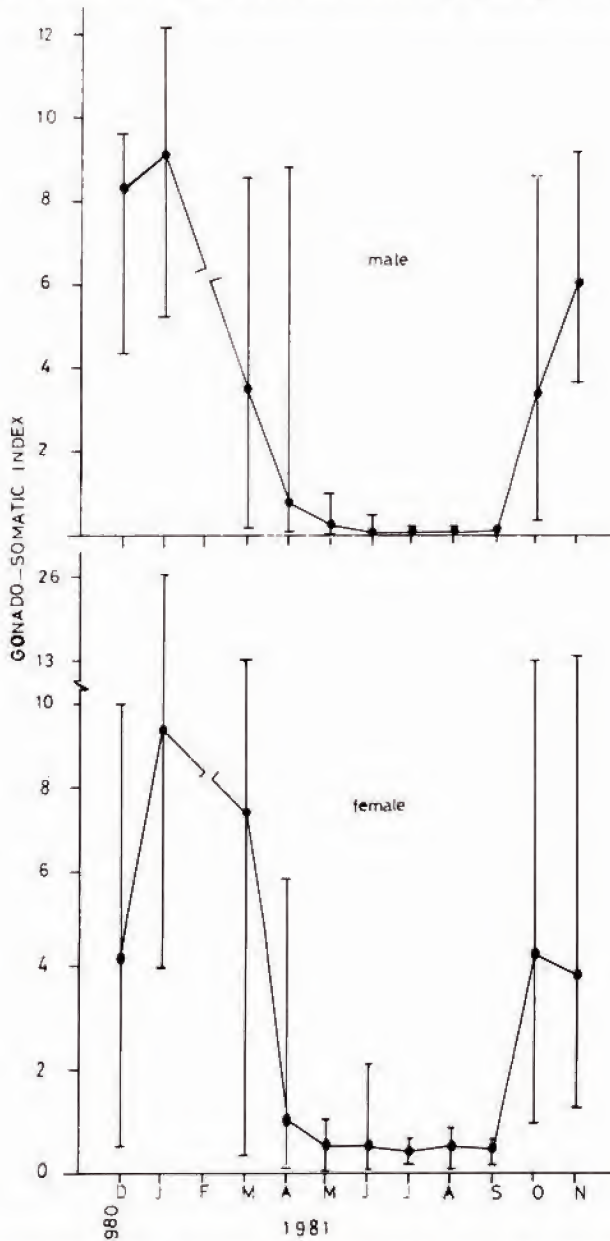


Fig. 3. — Monthly variations in the gonado-somatic index values of male and female *Liza abu*.

common in December and January (77.7 % of the males and 63.1 % of the females). Ripe fish (stage 5) were found during November to April and were most common in March (24.8 % of the males and 55.5 % of the females). Spent fish first appear in the March sample where they formed 28.5 % of the males but only 11.2 % of the females. In April all females and 83.3 % of the males were spent.

Gonado-somatic index (G.S.I.)

G.S.I. (the weight of the gonads expressed as a percentage of the body weight) can be used as an indicator of the breeding season. Monthly variation in G.S.I. value and mean (from standard deviation) for both sexes is shown in figure 3. The pattern of variation in males was similar to that of females. There was no distinct variation in G.S.I. values from May to September when most fish were in their resting stage. The G.S.I. increased noticeably in October and reaches its maximum value of 9.21 in males and 9.35 in females in January. A sudden fall was recorded in April. Wide ranges in values of G.S.I. were obtained during October to April.

Ovarian-eggs distribution

Egg diameter measurements of the 39 ovaries in different developmental stages are shown in figure 4. The total range in size of the intra-ovarian eggs was 0.1 - 0.75 mm. All the ova measuring 0.70 mm and above, could be produced easily by

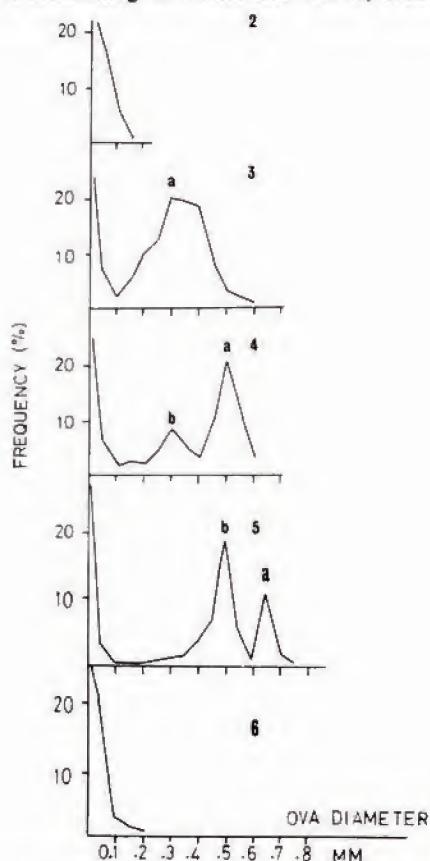


Fig. 4. — Frequency percentage of ova diameters at different maturity stages of female *Liza abu*.

slight pressure on the abdomen and these ova were assumed to be fully ripe. The next group of ova measuring 0.50 - 0.70 mm are in the late ripening stage of maturity. The ova measuring more than 0.10 mm and less than 0.50 mm are in the early ripening stage while all the remainder, smaller than 0.10 mm are immature. It was found that the number of immature ova was always comparatively greater than the number in all other stages of maturity. The successive increase in size of ova during maturation was an indicator of the progression toward the spawning condition. At stage 2 the immature ova occupied nearly all the ovary. By stage 3 there was a clear differentiation of the ripening eggs into a distinctly larger batch of eggs (mode a) and a less distinct batch of smaller eggs (mode b). At stage 4 the modes became even more distinct and the ova diameter in modes a and b shifts to 0.30 and 0.50 mm respectively. At stage 5 further shift of the modes takes place and the ova diameter in the first batch became 0.65 mm (fully ripe) while that of the second batch became 0.50 mm (late ripening). At stage 6 most of the ova were less than 0.10 mm.

Sex ratio

The number of males and females in the monthly catch during the period December 1980 to November 1981 are given in table II. Results in this table show that the number of females exceeded that of males during most months. When the fish are grouped according to length (table III), females also exceed males in some length groups, especially in length group 130-159 mm. The ratio of males to females in the whole sample (1:1.3) indicates, however, that the difference is not significant statistically ($p > 0.01$).

Table II. — The sex ratio in the different monthly samples of *L. abu*.

Month	No. of		Sex ratio
	males	females	
December 1980	18	33	1: 1.8
January 1981	27	19	1: 0.7
February	—	—	—
March	7	9	1: 1.3
April	24	24	1: 1
May	15	25	1: 1.6
June	18	38	1: 2.1
July	11	24	1: 2.4
August	13	18	1: 1.3
September	19	25	1: 1.3
October	23	24	1: 1.04
November	24	24	1: 1
Total	199	263	1: 1.3

Length and age at first maturity

Fish captured during the spawning period were used to determine the length and age at which first signs of maturation appear. Results are given in table IV.

Both sexes do not mature until they reach about 100 mm in total length. The largest immature male and female were 134 and 128 mm respectively. All males were mature at 160 mm while females attain this condition at 130 mm. At these lengths the fish are just less than one year old.

Table III.— The sex ratio in the different length groups of *L. abu*.

Length group	No. of		Sex ratio
	males	females	
40 - 69	2	2	1: 1
70 - 99	1	1	1: 1
100 - 129	26	30	1: 1.2
130 - 159	113	165	1: 1.4
160 - 189	47	50	1: 1.1
190 - 219	9	13	1: 1.4
> 220	1	2	1: 2
Total	199	263	1: 1.3

Table IV.— Percentage of mature males and females in different length groups of *L. abu*.

Length group mm	Male		Female	
	No.	% mature	No.	% mature
40 - 69	4	0.0	2	0.0
70 - 99	1	0.0	—	—
100 - 129	20	90.0	22	50.0
130 - 159	48	72.0	78	100.0
160 - 189	39	100.0	27	100.0
190 - 219	36	100.0	12	100.0
> 220	—	—	2	100.0

DISCUSSION

The population of *L. abu* in Al-hammar marsh has a prolonged breeding period extending from November to March. Luther (1963), mentioned a similar long breeding season for *Liza macrolepis* in Indian waters, where it lasts from June to February. Sarojini (1957), found that *Mugil parsia* in Indian waters has one long yearly spawning period extending from December to March. He noticed, however, two spawning maxima, one in January and the other in March.

The presence of all maturity stages of *L. abu* in the area sampled indicates that Al-hammar marsh is the spawning ground of this species and that there is no evidence of a spawning migration. Observations on fish catch indicate that the fish are caught almost all the year round. Sarojini (1957), mentioned that the fry of *M. parsia* ascend the estuaries in large numbers from January, and remain until Octo-

ber, when they begin to move back towards the sea and spawning takes place in deeper water near the mouth of the river. He found that at the foreshore area of the sea at Jaunput the fry or fingerlings of *M. persia* are caught all the year round, proving that the entire stock of fry does not migrate up river. He also reviewed many works on migration of mullets and reached the conclusion that observations on this aspect of their biology, to a large extent, are still controversial. For *M. cunnesius* no clearly defined or long range migration was noticed (Sarojini, 1958). El-Magharaby *et al.*, (1974), on the other hand, in their work on *Mugil capito* in Lake Borolus, Egypt, mentioned a movement of maturing fish towards the sea during November.

Gonado-somatic index values showed wide ranges during the spawning season suggesting that all individuals do not mature at the same time and that there is an extended spawning season (Morse, 1981).

Clark (1934), Hickling and Ruterburg (1936) and Annigeri (1963) considered that the distribution of intra-ovarian eggs is a reliable indicator of the spawning habits of fishes. The study of ova size distribution in the ovaries of *L. abu* and the monthly distribution of maturity stages support the fact that this species has but one prolonged spawning season. However, ova size distribution during this long spawning period showed that eggs could be shed in two batches.

Results on the sex composition of *L. abu* indicates that for the whole sample the sex-ratio was not significantly different, although collections for most months showed a slight female dominance. These results agree with those obtained by Luther (1963) for *L. macrolepis*, but differ from those obtained by many workers for many mugilids. El-Magharaby *et al.*, (1974) found that the number of female *M. capito* exceed that of males in most collections. Hussein (1969) found that the ratio for *Mugil saliens* of Lake Edca, Egypt was 6.6 females for each male. El-Zarka and El-Sedfy (1967) in their work on *M. saliens* in Lake Quarun, Egypt, also confirmed that female dominance is a common characteristic of Mugilidae. Segregation of the sexes, due to differences in age and size at which they mature, could be responsible for sex composition (Smith, 1956).

Length at first maturity, indicates that female and male *L. abu* mature at the end of their first year of life when they have reached a total length of about 100 mm. Results obtained by many workers show that, generally, larger mugilids attain sexual maturity at larger lengths and older ages. Erman (1959) found the maximum length of any *Mugil cephalus* he obtained was 620 mm (9 years old). The males and females attained sexual maturity during their fifth year of life when they were 400 and 415 mm in length, respectively. Luther (1963), in his work on *L. macrolepis*, showed that the maximum fork length for fish he obtained was 282 mm, and the males and females attained sexual maturity at about 160 and 170 mm, respectively. The results of this study indicate that longevity and the asymptotic length attained by these fish play an important role in determining their length and age at first maturity.

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